SURVEY OF FISHES, MAMMALS AND HERPETOFAUNA OF THE COLORADO RIVER IN GRAND CANYON

Royal D. Suttkus, Glenn H. Clemmer,
Clyde Jones, and C. Robert Shoop

Colorado River Research Program Final Report
Technical Report No. 5

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The Colorado River Research Program was initiated by the National Park Service in 1974 to secure scientific data to provide a factual basis for the development and the implementation of a plan for appropriate visitor-use of the Colorado River from Lee's Ferry to Grand Wash Cliffs and for the effective management of the natural and cultural resources within the Inner Canyons. The intensified research program consists of a series of interdisciplinary investigations that deal with the resources of the riparian and the aquatic zones and with the visitor-uses including river-running, camping, hiking, and sight-seeing of these resources, as well as the impact of use and upstream development upon canyon resources and visitor enjoyment.

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Contribution Number 34

Survey of Fishes, Mammals and Herpetofauna of the Colorado River and Adjacent Riparian Areas of the Grand Canyon National Park

by

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Abstract

The primary purpose of our survey study was to obtain a body of "base-line" data.

Eleven extensive float trips plus several single site collections were made from September 1970 through the middle of June 1976. One hundred twelve fish collections were obtained from 35 localities. A total of nineteen species was collected and of these, four species are native and fifteen introduced. No evidence was found that river running parties had any impact on fish populations. The major impact on the fishes (particularly the native fishes) in the Grand Canyon area is the Glen Canyon Dam and the downstream conditions produced by its operation.

Mammal collections were obtained from 35 sites. A total of 795 dry study skins and skeletons were prepared. This total represented twenty four species. Reptile and amphibian specimens were obtained from 46 localities. The total of 285 specimens represent nineteen forms. Forty five plant collections were obtained from 31 different localities. Slightly over 2400 sheets will result when all specimens are mounted.

During the last part of the survey, i.e., during the period of the contract our efforts with regards to terrestrial studies were concentrated at ten sites: Lee's Ferry, River Mile 0, right bank; River Mile 19, left bank; Buck Farm Canyon, River Mile 41, right bank; Unkar, River Mile 72, right bank; Boucher Creek, River Mile 96.5, left bank; Lower Bass Camp, River Mile 108.5, right bank; Deer Creek, River Mile 136.2, left bank; Tuckup Canyon, River Mile 164.5, right bank; Bridge Canyon Dam site, River Mile 238, left bank; Scorpion Island, River Mile 279.5, left bank.

No evidence was found that river running parties had any adverse effects on the small mammal, reptilian or amphibian populations.

Additional collections and observations will have to be made in order to provide an adequate amount of basic information for comparison with future monitoring samples. Certainly ten small sites in 560 miles of riparian zone could not be interpreted as over sampling.

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Introduction

The senior author made six float trips down the Colorado River before engaging in a contract with the National Park Service. The first trip was taken in September 1970, starting at Lee's Ferry and terminating at Phantom Ranch. The next four float trips, August 1971, July 1972, May 1973, and August 1973, started at Lee's Ferry and ended at Temple Bar on the south shore of Mead Reservoir. The Sixth trip, May 1974, started at Lee's Ferry and terminated at Diamond Creek. Biological specimens of the various groups were collected during these six trips and data from these specimens are included in this report. Most of our effort was directed toward fishes and mammals during these early trips, for example 35 of the 112 fish collections and 36 of the 82 mammal collections were obtained during the six trips. The trips with the commercial river runners would have been much less productive were it not for the understanding and help given by a few boatmen. Outstanding in this regard was Patrick Conley.

Four float trips supported by National Park Service were made in 1975. The first of these trips started at Lee's Ferry on April 22 and terminated at Diamond Creek on May 5. This was a rowing trip in accompaniment with the Museum of Northern Arizona personnel. We were particularly pleased and most appreciative of the efficient handling of the trip itinerary by the boatman, Scott Imsland. The next float trip in 1975 started on June 3 and ended on June 12 at Diamond Creek. The third trip in 1975 began at Lee's Ferry on July 28 and terminated at Pierce Ferry Landing on the south shore of Mead Reservoir on August 6. The last trip of 1975 began at Lee's Ferry on September 19 and ended at Diamond Creek on September 26. These latter trips were under the guidance of Steve Martin and his wife Cyd. We extend our sincere appreciation to both of them for personal efforts which they made to help us obtain the maximum amount of data.

Four trips were made to the Grand Canyon during the first half of 1976. The first of these was made at the end of February and because one collecting permit was lacking only observations were made at the mouth of the Paria River. The second trip was made during the end of March and first part of April. Collections were obtained from the mouth of the Paria River. The third trip made in early May included collecting from the Paria River and from the mouth of the Little Colorado River and from along the left bank of the Colorado River just below Lava Canyon Rapid. We were taken by helicopter to the mouth of the Little Colorado River on May 5, went by Park Service boat to Lava Canyon Rapid area on May 6 and were picked up by helicopter on May 7. The fourth trip during 1976 started at Lee's Ferry on May 31 and ended at Pierce Ferry Landing on the south shore of Mead Reservoir on June 9.

During the early trips with the commercial river runners the following persons were helpful in making numerous collections: Ramona Suttkus, Charles Carson, Margaret Mathews, Deborah Robertson, Leah Straub, Alice Stevenson, Lyn Branch, Mark Stevens, and Sherry Clemmer. The following persons aided us to a lesser extent: Johnine Pike, Pat Moss, Stephen Gayle, Linda Donley, Bill Boultinghouse, Robert Mayer, Susan Passel, Jan Suttkus, Daniel Earle, Cindy Earle, Steve Kopecky and Steve Bledsoe. We wish to acknowledge the many hours of help of the following during the 1975 and 1976 trips: Robert Esher, James Deacon, Maxine Deacon, Cindy Deacon, Linda Loetterle, Dawn Remington, Jayson Suttkus, Barry Kohl, Gail Kohl, Jeanne Suttkus, James Williams, and Robert Fisher. All photographic work included in this report was done by Jeanne Suttkus.

The initial plans for a biological survey of the Grand Canyon area were formulated in 1971. The intent was to obtain a set of base-line data with regards to fishes and mammals. This was expanded to include herpetofauna and the typical plants in the riparian area. Early in 1975 during the initial stages of the contract with the National Park Service our plans were modified so as not to conflict or interfere with the

studies being done by the Museum of Northern Arizona staff. Specifically, we discontinued our collecting efforts of mammals and herps in the Cardenas Creek area at Mile 71 and directly across the river along the right bank at Mile 71. Also we refrained from collecting the terrestrial vertebrates from the Granite Park site (River Mile 209). No efforts were made to study or collect large mammals. Some sight records were recorded and are given in the appropriate following section.

The aquatic studies and the terrestrial studies had somewhat different orientations. Fish collecting was done in the mouths of tributaries primarily, although the main Colorado River was sampled in a few places. Most of these tributary sites and main river sites were visited during the day and so perhaps were less productive than if the collecting had been done at night. The aquatic studies extended from Lee's Ferry (River Mile 0) down to Pierce Ferry Landing (River Mile 280).

The terrestrial studies were done during both day and night conditions and the locations coincided with camp sites. We chose ten sites as our primary study sites, the upper at Lee's Ferry (River Mile 0) and the lower at Scorpion Island (River Mile 279.5) on the south shore of the Mead Reservoir. The terrestrial study site at Sandy Point (River Mile 294.5) along the south shore of the Mead Reservoir although formerly (1972) an excellent area for small mammals was destroyed by inundation to a depth of several meters. Large releases of water from the Powell Reservoir were stored in the Mead Reservoir thus destroying thousands of acres of small mammal habitat.

Names of fishes used in this report in general follow the publication: "A list of common and scientific names of fishes from the United States and Canada", by Bailey, et al. The names of mammals follow: "Mammals of Grand Canyon", by Hoffmeister and the names of reptiles and amphibians follow: "A field guide to western reptiles and amphibians", by Stebbins.

The identifications of fishes, mammals and plants used in this report are those of Royal

D. Suttkus and the identifications of reptiles and amphibians are those of C. Robert Shoop.

All specimens presently are being held at Tulane University, Museum of Natural History. Only the fishes have been cataloged in the Tulane University collection. All other specimens are on hold status and will remain uncataloged until basic study has been completed. The decision with regard to the permanent depositories will be made at a later date.

A few additional remarks with regards to our last float trip (May 31 to June 9, 1976) are given to illustrate the large amount of data that can be obtained when an adequate working crew is available. Every individual in our group was an essential part of a working team. The following is a list of specimens prepared:

215 mammal study skins and skeletons
24 sets of mammalian embryos
144 reptiles and amphibians
590 fish specimens
626 herbarium sheets of plants
25 rolls of black and white habitat photos
12 rolls of color photos of flowering plants, reptiles and amphibians

Many reptiles and amphibians were caught, photographed and then released at the same site from which they were collected. In addition to the collection and preparation of specimens, several sets of field notes were written by the various members of the group.

Our boatmen, Scott Thybony and Ken Hawkins, also deserve credit for the success of our trip. Every request to stop for collections, to make observations, or to "push-on" to a specific campsite was honored. We had complete cooperation throughout the trip which enabled us to maintain a fast and efficient working pace.

FISHES

Fish collections were obtained from thirty five different sites along the Colorado River in Coconino and Mohave counties in Arizona from September 1970 through the middle of June 1976 (Appendix A). The uppermost collecting site was at Lee's Ferry, River Mile 0, and the lowermost site was along the south shore of the Mead Reservoir at Pierce Ferry Landing (River Mile 280). Nearly all of the 112 collections were obtained with a small-mesh minnow seine. A total of 6,352 specimens was obtained from the 35 sites. Nineteen species plus one hybrid sucker combination and at least one hybrid trout combination were taken during the course of the study (Appendix B). No attempt will be made to decipher the various trout hybrids of which there may be more than one combination in the tributaries.

Even before impoundment the Colorado River in the Grand Canyon area was not species rich with native fishes. Perhaps eight or as many as ten species once lived in the Grand Canyon area of the Colorado River. However few, most of the forms are unique and occur nowhere naturally outside of the Colorado basin. The introduction of exotic fishes into the Colorado River has added biological pressures on the native fishes. Fifteen of the nineteen fish species taken during the study are introduced. Three of the four native species seem to be holding their own because they utilize a number of small tributaries as well as the larger tributaries for spawning. The three species are the flannelmouth sucker, Catostomus latipinnis, the bluehead sucker, Pantosteus discobolus and the speckled dace, Rhinichthys osculus.

Our records indicate that the flannelmouth sucker can tolerate higher temperatures both for spawning and as a habitat for the young. Adult, young or both were taken from the Paria River (Mile 0), Little Colorado River (Mile 61.5), Clear Creek (84.2), Bright angel Creek (87.7), Crystal Creek (98.2), Shinumo Creek (108.7), Royal Arch Creek (116.5), Deer Creek (136.2), Kanab Creek (143.5), Matkatamiba Creek (148), Havasu Creek (156.7), National Canyon Creek (166.5), Diamond Creek (225.5) and Spencer Creek (246). In addition to the tributary collections the flannelmouth sucker was obtained from

the main channel of the Colorado River at the following places: River Mile 41, 44, 50, 65.8, 71, 87.5, 194.5, 209 and 212.5. Data on reproduction were recorded a number of times for the flannelmouth sucker at the Paria River site. During a late February 1976 visit to the area a number of ripe male flannelmouth sucker were captured and then released. Although many females were seined none was ripe. Each month thereafter until the end of May samples were collected from the mouth of the Paria River and reproductive information recorded. Nearly all male and female flannelmouth sucker appeared to be spawned-out at the end of May, however a few males had moderate-size tubercles.

The bluehead sucker, Pantosteus discobolus, was taken from all the tributaries listed above for the flannelmouth sucker collections except for Clear Creek and Matkatamiba Creek. It was taken from the same main river sites except for River Mile 65.8, 209, and 212.5. A single specimen of the bluehead sucker was taken from Tapeats Creek on July 24, 1972. No flannelmouth sucker specimens were taken from Tapeats Creek. Although two different forms of bluehead sucker are recognized we treat them collectively for the purpose of this report. The systematic status of this varied form and of the flannelmouth are under study and our findings will appear elsewhere. Reproductive data were recorded for the bluehead sucker at a number of tributaries. Spawning was observed a number of times. The longest periods of observations were made at Shinumo, Kanab and Havasu Creeks. Numerous ripe specimens were collected at the mouth of the Paria River but water was always turbid which prevented direct observations. In general spawning takes place earlier in the warm downstream tributaries such as Kanab Creek.

No specimens of the humpback sucker, Xyrauchen texanus, were taken during the entire course of the study. We did collect three specimens of the hybrid combination, Catostomus latipinnis X Xyrauchen texanus. We believe the humpback sucker has been forced out of existence in the Grand Canyon section of the Colorado River. The low water temperatures that continue to prevail because of the base releases from the Glen Canyon dam are too cold for spawning. Secondly, the humpback sucker apparently

does not utilize any of the small tributaries that are available in the Canyon area. Thirdly, the dam is a barrier that prevents upstream movement to suitable spawning areas. We postulate that during the early part of the period when the Powell Reservoir was being filled the dam acted as a barrier but water temperatures remained suitable for spawning thus humpback sucker being greatly out numbered by flannelmouth sucker hybridization between the two forms resulted. Now since spawning conditions are completely unfavorable for the humpback sucker it is being genetically swamped-out by the flannelmouth sucker.

We are greatly concerned about the status of the chubs of the genus Gila in the Grand Canyon area of the Colorado River. We collected one adult humpback chub, Gila cypha, from Shinumo Creek on August 1, 1975. This individual was photographed and released. Four adult Gila cypha were taken from the Little Colorado River near its mouth on June 2, 1976 (Figure 1). These four specimens are cataloged in the Tulane University fish collection. No adult specimens of the bonytail, Gila elegans, were taken during the survey. Identification of young and small juvenile specimens of Gila has not been made up to this time. Young or small juvenile Gila were taken at River Mile 44, Little Colorado River and in Colorado River at mouth of Little Colorado River (River Mile 61.5), at River Mile 69, at River Mile 71, and from mouth of Shinumo Creek (River Mile 108.7). Although Holden and Stalnaker (1970) reported specimens of Gila from Lee's Ferry our numerous attempts with a small-mesh seine revealed no Gila of any age or size. Our several attempts at the mouth of Bright Angel Creek also proved to be fruitless with regards to Gila. We believe that the impoundment of the Colorado River by the Glen Canyon dam and the subsequent continuous unnatural releases of cold bottom water has had a devastating effect on the Gila population. We believe our samples are adequate evidence that the distribution of Gila in the Grand Canyon has been reduced to an area near and extending a few miles below the mouth of the Little Colorado. Further, we believe the continuance of the Little Colorado River in its present physical and chemical state is essential

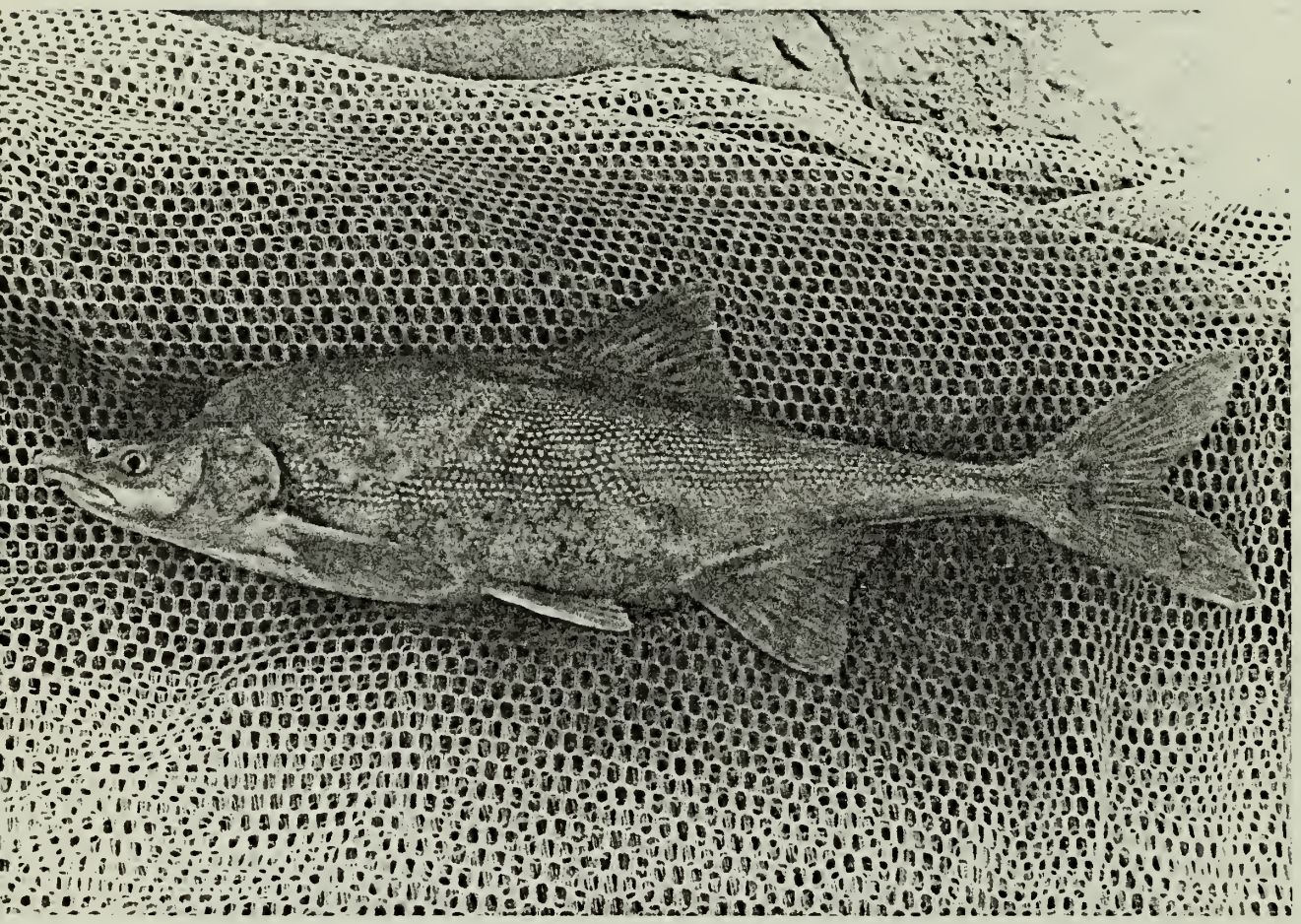

Figure 1: Humpback Chub, Gila cypha.

to the survival of Gila in the Grand Canyon area. The Little Colorado River and the main Colorado River downstream to Shinumo Creek is critical habitat.

Our survey did not disclose any specimens of the Colorado squawfish, Ptychocheilus lucius. Numerous sampling sites should have produced young or juveniles if the species still existed in the Grand Canyon area. We are convinced that the Colorado squawfish was extirpated from the Canyon area by impoundment and the conditions that prevailed following impoundment.

The speckled dace, Rhinichthys osculus, is perhaps more widely distributed within the Grand Canyon area than either the flannelmouth or bluehead suckers. This is based on collections of speckled dace from a number of very small tributaries from which neither sucker species was taken and that it was collected from nearly every site from which we obtained the suckers. The small tributaries from which speckled dace were collected and no suckers were Hermit Creek (River Mile 95), Boucher Creek (River Mile 96.5), Blacktail Canyon Creek (Mile 120), Stone Creek (Mile 132) and Travertine Creek (Mile 229). There were considerable differences in color, color pattern and body shape of those speckled dace taken from tributaries and those taken from main river.

The threadfin shad, Dorosoma petenense, an exotic form presumably was introduced as a forage species for the large introduced game species. The threadfin shad was collected at Spencer Creek (Mile 246), at Emory Falls (Mile 274.3) and at Scorpion Island (Mile 279.5).

A single specimen of the coho salmon, Oncorhynchus kisutch was seined at River Mile 194.5 on August 16, 1971.

The introduced rainbow trout Salmo gairdneri, and various hybrid combinations were taken from most of the tributaries and various places along the main river. No young or juveniles were ever collected around the mouth of the Paria River and we suspect that little if any spawning is successful in that part of the river.

The carp was the most widely and continuously distributed exotic species in the Grand Canyon

area. Schools of individuals were observed in the main river from Lee's Ferry down to and along the shores of the Mead Reservoir and at the mouths of all moderate to large size tributaries. For example, a group of 21 was observed at River Mile 34 on July 29, 1975 and twelve were collected from the mouth of Kanab Creek on June 9, 1975. The uppermost site for young or juvenile carp was the Little Colorado River (Mile 61.5). Young or juveniles were taken at Cardenas Creek area (Mile 71), River Mile 194.5 and at Emory Falls in the Mead Reservoir (Mile 274.3). All other collections and sightings were of adults thus indicating that the conditions prevailing in the upper stretches of the Colorado River around Lee's Ferry is not favorable spawning area even for the tolerant carp.

A single specimen of the virgin spinedace, Lepidomeda mollispinis, was collected from the mouth of the Paria River on July 19, 1972.

A single specimen of the golden shiner, Notemigonus crysoleucas, was collected from Kanab Creek (River Mile 143.5) on June 9, 1975.

The red shiner, Notropis lutrensis, was collected from five different sites. On August 16, 1971 five specimens were collected at River Mile 194.5 and one specimen from River Mile 212.5. Subsequently no more specimens were collected above the head of tne Mead Reservoir. The red shiner was collected at Spencer Creek (Mile 246) on August 5, 1975 and June 8, 1976. It was collected at Scorpion Island (Mile 279.5) and Pierce Ferry Landing (Mile 280) on August 5 and August 6, 1975 respectively.

The fathead minnow, Pimephales promelas, another introduced bait fish apparently can tolerate the coldwater conditions better than the red shiner which is a native of the lower Mississippi Valley. The fathead minnow was collected from 16 different sites, the uppermost locality was River Mile 44 and the lower most was Spencer Creek (River Mile 246). It was collected five different times at the mouth of the Little Colorado, four times at Royal Arch Creek and four times at Deer Creek.

The channel catfish, Ictalurus punctatus, was collected from six different sites: Little

Colorado River, Cardenas Creek area (Mile 71), Shinumo Creek, Kanab Creek, River Mile 194.5, and Spencer Creek. It was collected at the Little Colorado River mouth twice, four times from mouth of Kanab Creek and once from each of the other sites.

The Rio Grande killifish, Fundulus zebrinus, seems to be well established at a number of tributaries. This introduced killifish was collected six different times at the mouth of the Little Colorado River, three times at the Cardenas Creek area (River Mile 71), and four times at Crystal Creek and both times that we collected at Spencer Creek. The Rio Grande killifish is abundant at Spencer Creek and during the last trip on June 8, 1976 many spawning groups were observed. The Rio Grande killifish was collected from ten different sites, the upper most at the Little Colorado and the lowermost at Spencer Creek.

The mosquitofish, Gambusia affinis, was collected at two sites: Emory Falls (Mile 274.3) and Pierce Ferry Landing (Mile 280).

A dead striped bass, Morone saxatilis, was observed floating in the Mead Reservoir at approximately River Mile 250. It was just under 700 mm. in total length.

The green sunfish, Lepomis cyanellus, bluegill, Lepomis macrochirus, and the largemouth bass, Micropterus salmoides, were collected at Spencer Creek. In addition, the largemouth bass was collected at Emory Falls and Scorpion Island.

Water temperature was measured and recorded at the place and time of each fish collection except for during one early trip when the thermometer was broken during the loading process at the beginning of the trip.

Temperature data are given for the May 30 - June 9, 1976 trip in Appendix E. The Colorado River varied from a low 10°C at Lee's Ferry on May 30 to a high of 13°C at Kanab Creek. Tributaries and shallow side pools varied from a low of 17°C in Royal Arch Creek to a high of 27.5°C in Spencer Creek.

Mammals, Herpetofauna and Plants

During the entire survey 795 dry mammal specimens were prepared. Most of these are represented by a study skin and skeleton. No adult mammals were pickled. In addition to the dry preparations 35 sets of embryos were pickled. The 795 specimens represent samples taken from 35 sites along the Colorado River from Lee's Ferry (River Mile 0) down to Sandy Point (River Mile 294.5) (Appendix C). Twenty four species are represented (Appendix D). With respect to Hoffmeister's (1971) cited locality records for bat collections all of our collections are new locality records. Our record of the fringed bat Myotis thysanodes, from River Mile 19 is the first record from the bottom of the canyon. Hoffmeister gives distribution of the Yuma myotis, Myotis yumanensis, as lower portions of the canyon. Our records from Buck Farm Canyon, River Mile 41, show that the Yuma myotis does range above the Phantom Ranch area (River Mile 87.7). Hoffmeister cited only two localities for the bigear bat, Plecotus townsendii. Both of these localities were up on the South Rim. We have the bigear bat from River Mile 19, 41, 72 and 164.5. Hoffmeister gave one locality in the canyon (Phantom Ranch) for the pallid bat, Antrozous pallidus. We have two specimens of the pallid bat from River Mile 19. Apparently our specimen of the freetail bat, Tadarida brasiliensis, from Lower Bass Camp (River Mile 108.5) is the first record from down in the canyon. Our locality records for the deermouse, Peromyscus maniculatus, from the riparian area add four more sites to the three that Hoffmeister gave for the inner gorge. We have obtained the deermouse for three riparian sites along right (north) side of the river (River Mile 0, 41, and 72) and one site along the left (south) side of the river (River Mile 96.5). The pinon mouse, Peromyscus truei, contrary to Hoffmeister does occur in habitat distant from pinon pine trees. We collected the pinon mouse in the riparian area at Lee's Ferry and at Tuckup Canyon, River Mile 164.5.

The recorded sightings for larger animals not collected were as follows: coyote, Canis

latrans, River Mile 277-R on June 8, 1976; gray fox, Urocyon cinereoargenteus, Mile 0-R on May 30, 1976 and Mile 51-R on September 21, 1975; mule deer, Dama hemionus, Mile 36.5 on August 10, 1971, two at Mile 50-R on April 25, 1975, Mile 51.5-L on August 11, 1971, two at Mile 54-R on July 22, 1972, two at Mile 57.5-L on April 26, 1975, and at Mile 58.7-L on August 11, 1971; and Bighorn sheep, Ovis canadensis, at Mile 116-L on August 14, 1971, three at Mile 126.7-L on September 24, 1975, at Mile 165-L on September 24, 1975, four at Mile 202-L on September 25, 1975, at Mile 206-L on August 4, 1975 and seven at Mile 215-L on June 11, 1975. All (14) recorded sightings of burros, Equus asinus, were on the right side of the river between River Mile 208 and 220.

Reptile and amphibian specimens were obtained from 46 localities ranging from Lee's Ferry (River Mile 0) down to Scorpion Island (River Mile 279.5) (Appendix E). A total of 285 specimens was preserved. Nineteen forms are represented by photograph or by photographs and specimens (Appendix F).

Forty five plant collections were obtained from 31 different localities along the Colorado River (Appendix G). A few specimens from the last trip are not mounted as yet but we will have slightly over 2400 herbarium sheets when the job is finished. Most plant specimens are associated with mammal collections however we have a few aquatic plant collections that were associated with fish collections. The majority of the plant specimens were taken from our ten primary study sites.

Hoffmeister (1971:18) gives the cottonwood, Populus fremontii, willow, Salix lasiolepis, desert willow, Chilopsis linearis and tamarix, Tamarix pentandra, as trees included in the riparian community. There is no question about the presence of the tamarix and the willow but the cottonwood and desert willow are not common or typical of the riparian zone along the main Colorado River. The cottonwood is common in many of the side canyons but we found the desert willow only at a single site. A few desert willow were observed on each side of the Colorado River at Granite Park (River Mile 209). We found Brickellia

sp., Baccharis sp., Pluchea sericea and Cercis occidentalis to be more typical along the Colorado River.

We would like to report two exotic plants that other workers may not have recorded. We removed two leaves only from a small palm tree that is growing near the mouth of the Little Colorado River and collected the entire plant of a garden tomato that was growing at the Lower Bass Camp (River Mile 108.5).

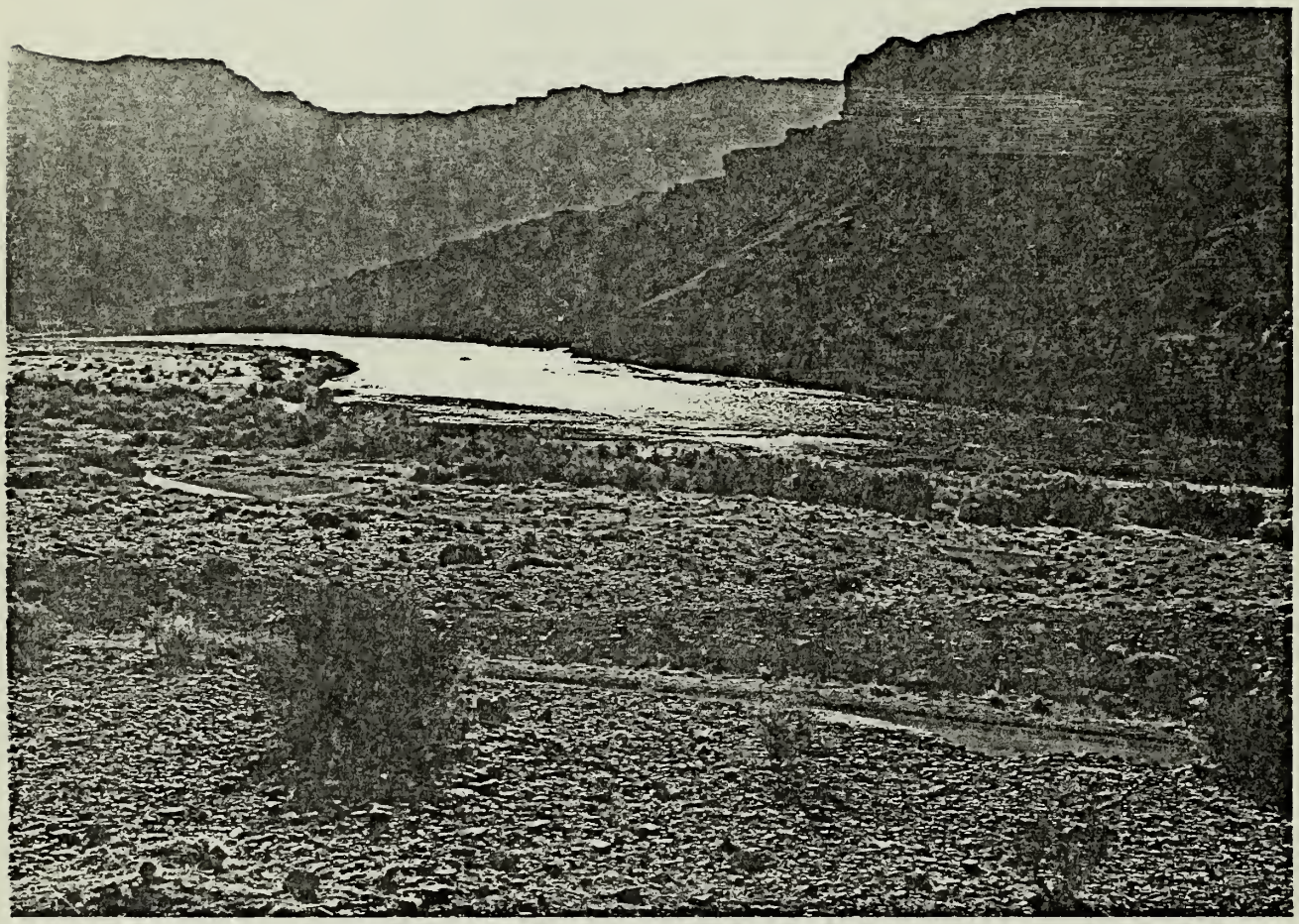

Figure 2: Lee's Ferry - River Mile 0 - Right Bank

Primary Study Sites

As stated above our terrestrial samples were taken from along the Colorado River at Lee's Ferry area (Mile 0) down to Sandy Point Mile 294.5). Late in 1975 after the contract was negotiated we decided to concentrate our efforts at ten sites. These ten sites are along the right bank at Lee's Ferry (Mile 0), along the left bank at River Mile 19, along the right bank at Buck Farm Canyon (Mile 41), along the right bank at Unkar (Mile 72), along the left bank at Boucher Creek (Mile 96.5), along the right bank at Lower Bass Camp (Mile 108.5), along the left bank across from Deer Creek (Mile 136.2), along the right bank at Tuckup Canyon (Mile 164.5), along the left bank at Bridge Canyon dam site (Mile 238) and at Scorpion Island (Mile 279.5).

Our intent was to accumulate a body of basic data for each of the ten sites. The biological specimens serve as documentary evidence from the date of collection. Too, the written recorded observations and habitat photographs made at the time of collection of specimens are essential basic data. Needless to say the collections and observations made at other places along the 280 mile course of the Colorado River are valuable in obtaining a better perspective of the ten sites. The right and left bank of the river differ in a number of ways and thus a rephrase would emphasize the foregoing point. We have ten sample sites in more than 560 miles of riparian habitat.

Lee's Ferry - Mile 0
Figure 2

Lee's Ferry area seems to be a logical sampling site. It is the starting point of all float parties and receives the maximum of human traffic. Also it has had a long history of human habitation. Unfortunately no one collected biological specimens (to our knowledge) from this site in former years. However, Rusho and Crampton (1975) show a photograph of the Lee's Ferry Ranch in which there is a large

cottonwood in the foreground. Also the authors state that in 1859 Thales Haskell noted in his diary that water, grass and cottonwood were present near the mouth of the Paria River. There are no large cottonwood present in the area today.

In general the area is composed of the lower gentle slopes of the Moenkopi. These slopes are dissected by dry washes. At the down river side of the study area the top of the Kaibab limestone appears.

Our plant collections from the Lee's Ferry area are the most extensive for any of the ten sites. Our mammal collections are not adequate to represent this rather extensive diverse area. We did obtain a few specimens from the proposed new parking areas that will soon be surfaced over with either black-top or concrete. We have specimens of the following: Myotis californicus, Ammospermophilus leucurus, Perognathus sp., probably formosus, Peromyscus boylii, Peromyscus eremicus, Peromyscus maniculatus, Peromyscus truei and Neotoma lepida. In addition the gray fox Urocyon cinereoargenteus, blacktail jackrabbit, Lepus californicus and the beaver, Castor canadensis have been observed in the area. There is a beaver house along the bank of the Colorado River just below the launching area for the float trips. There is a bank den along the lower stretch of the Paria River.

The following reptiles and amphibians have been collected from the Lee's Ferry area: Bufo punctatus, Bufo woodhousei, Hyla arenicolor, Cnemidophorus tigris, Sceloporus magister, Uta stansburiana, Crotaphytus insularis, and Salvadora hexalepis

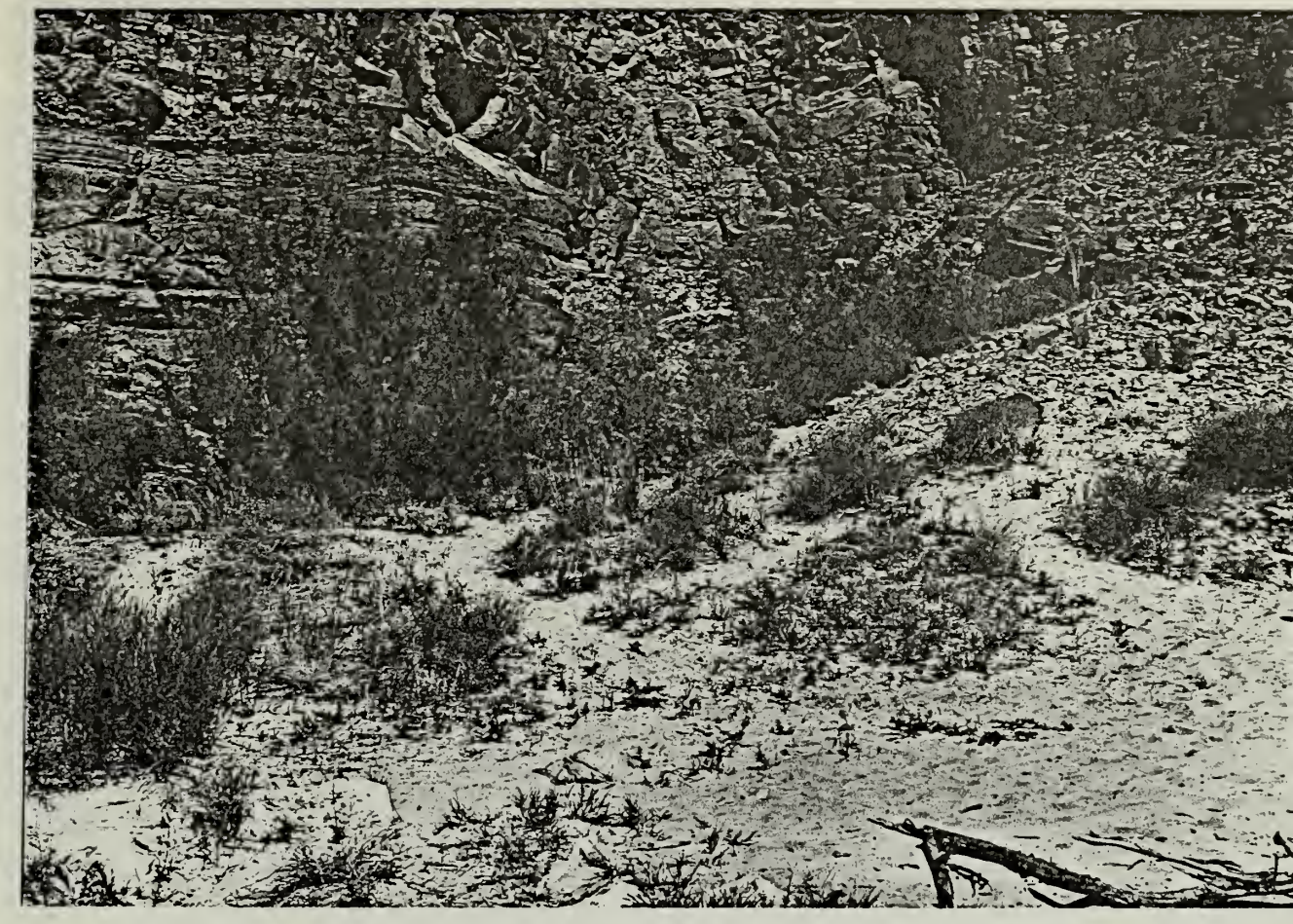

Figure 3: River Mile 19 - Left Bank

This study site is along the left bank of the river at the base of the Supai formation. The talus slope is narrow and steep at this point thus providing a limited study area. Our plant samples from this site probably represent most of the perennials but perhaps only a small percentage of the annuals.

The following mammals were obtained: Myotis californicus, Myotis thysanodes, Plecotus townsendi, Antrozous pallidus, Peromyscus boylii, Peromyscus crinitus, Peromyscus eremicus and Neotoma lepida. The following reptiles and amphibians were collected from the Mile 19 site: Bufo punctatus, Bufo woodhousei, Scaphiopus hammondi, Cnemidophorus tigris, Sceloporus magister, Uta stansburiana, and Urosaurus ornatus.

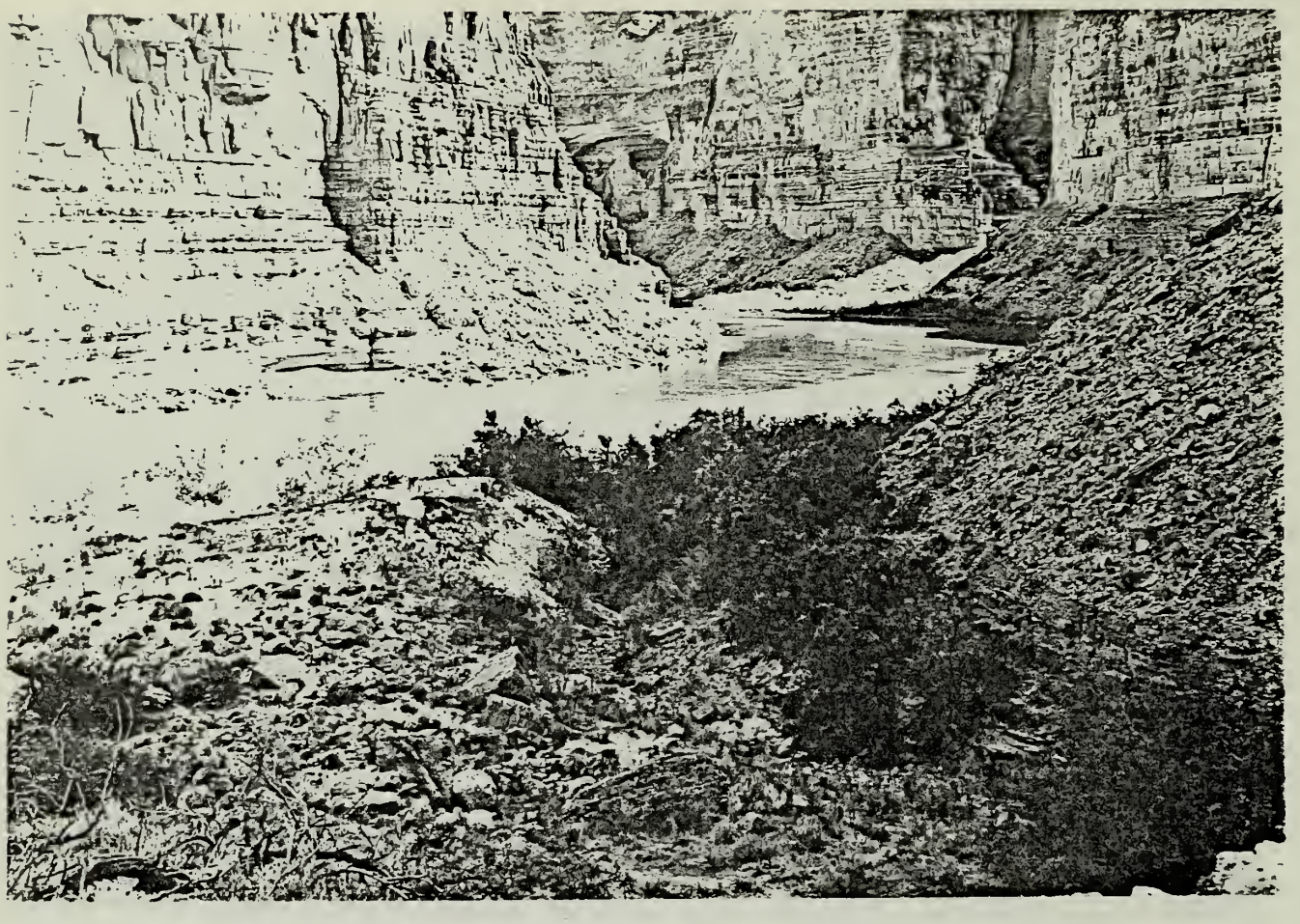

Figure 4: Buck Farm Canyon - River Mile 41 - Right Bank

This is an extensive deltaic fan area along the right bank of the Colorado. The deltaic fan of Buck Farm Canyon abuts against the steep slope of the Muav limestone which in turn slopes up to the base of the vertical Redwall limestone. Our plant samples are representive of the perennials and annuals at or near the camping area but not at the upper or lower ends of the deltaic fan nor from up in Buck Farm Canyon. Mammals taken at Buck Farm are as follows: Myotis californicus, Myotis yumanensis, Plecotus townsendii, Reithrodontomys megalotis, Peromyscus boylii, Peromyscus crinitus, Peromyscus eremicus, Peromyscus maniculatus, and Neotoma lepida. The following reptiles and amphibians were collected from Buck Farm: Bufo punctatus, Bufo woodhousei, Hyla arenicolor, Cnemidophorus tigris, Sceloporus magister and Uta stansburiana.

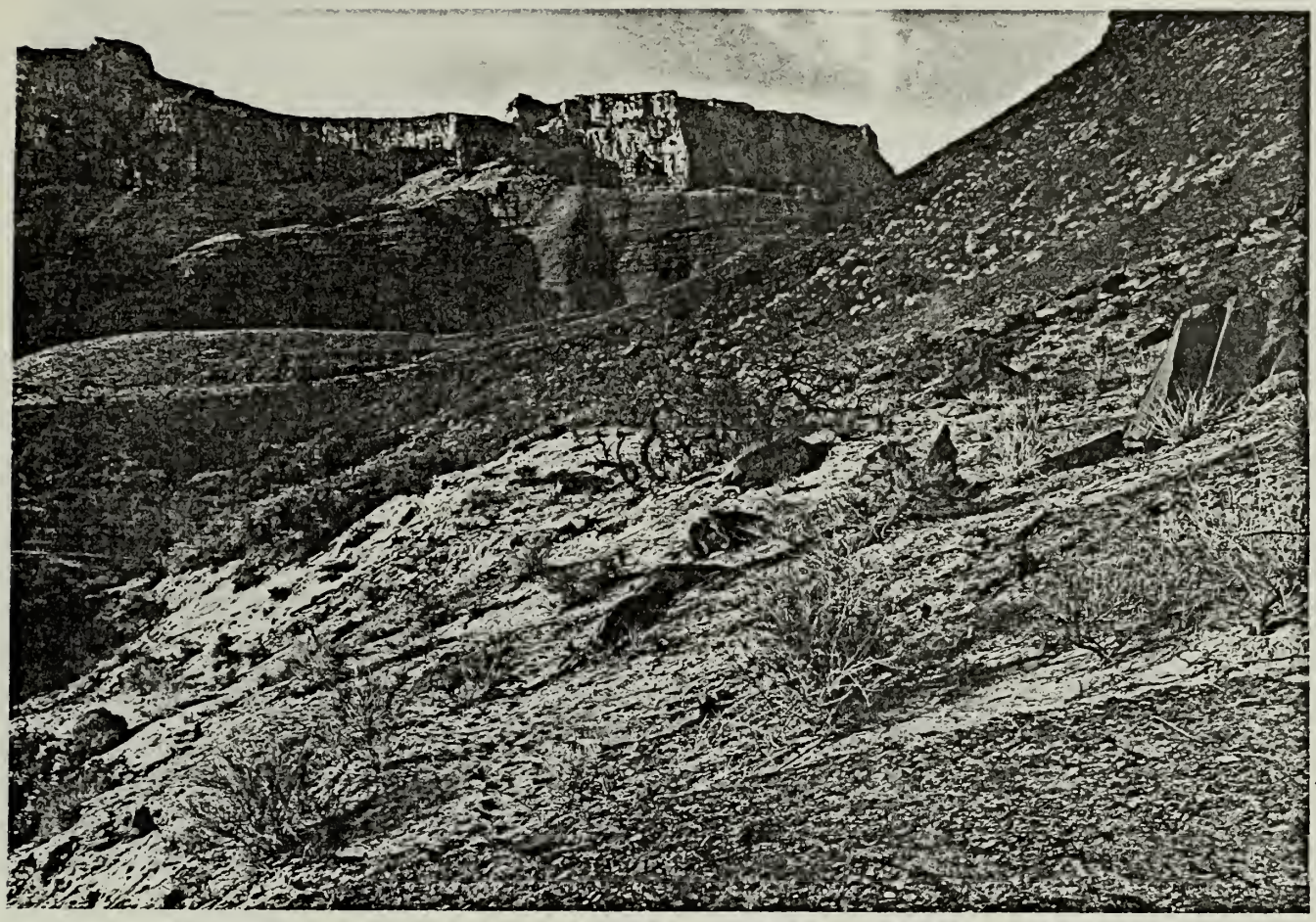

Figure 5: Unkar - River Mile 72 - Right Bank

At this site along the right bank just upstream from Unkar Rapid the steep slope is that of Dox sandstone of the Grand Canyon series. Our plant samples are quite limited from the slopes immediately away from the river's edge. Mammals from this site include Plecotus townsendii, Perognathus formosus, Peromyscus boylii, Peromyscus crinitus, Peromyscus eremicus, Peromyscus maniculatus, and Neotoma lepida. The reptile and amphibian collections include Sceloporus magister, Uta stansburiana, Sauromalus obesus and Crotaphytus insularis.

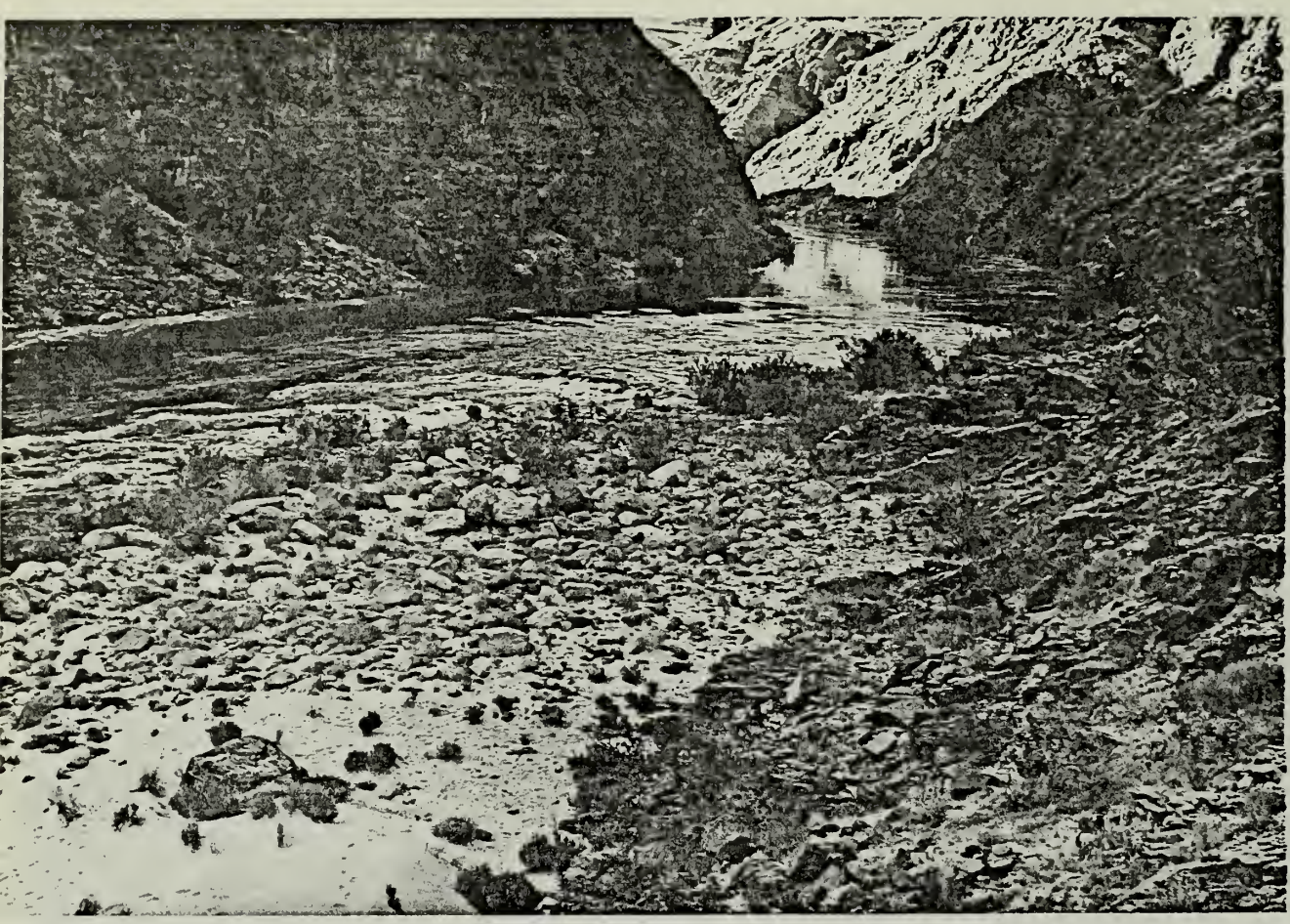

Figure 6: Boucher Creek - River Mile 96.5 - Left Bank

Boucher Creek is a small flowing tributary which enters the Colorado from the left. This site is located approximately in the middle of Upper Granite Gorge. The jagged Vishnu schist and Zoroaster granite walls are but a short distance from the rivers edge at the study site. The small boulder strewn fan from Boucher Creek is adjoined in the downriver direction by a narrow sandy area. Immediately downriver the schist and granite form a vertical wall at the rivers edge. Some collecting was done in the lower part of Boucher Creek canyon. Mammals taken at Boucher Creek site were Myotis californicus, Pipistrellus hesperus, Perognathus intermedius, Peromyscus crinitus, Peromyscus eremicus, Peromyscus maniculatus, and Neotoma lepida. Two amphibians, Bufo punctatus and Hyla arenicolor and two reptiles, Coleonyx variegatus and Uta stansburiana were collected at Boucher Creek.

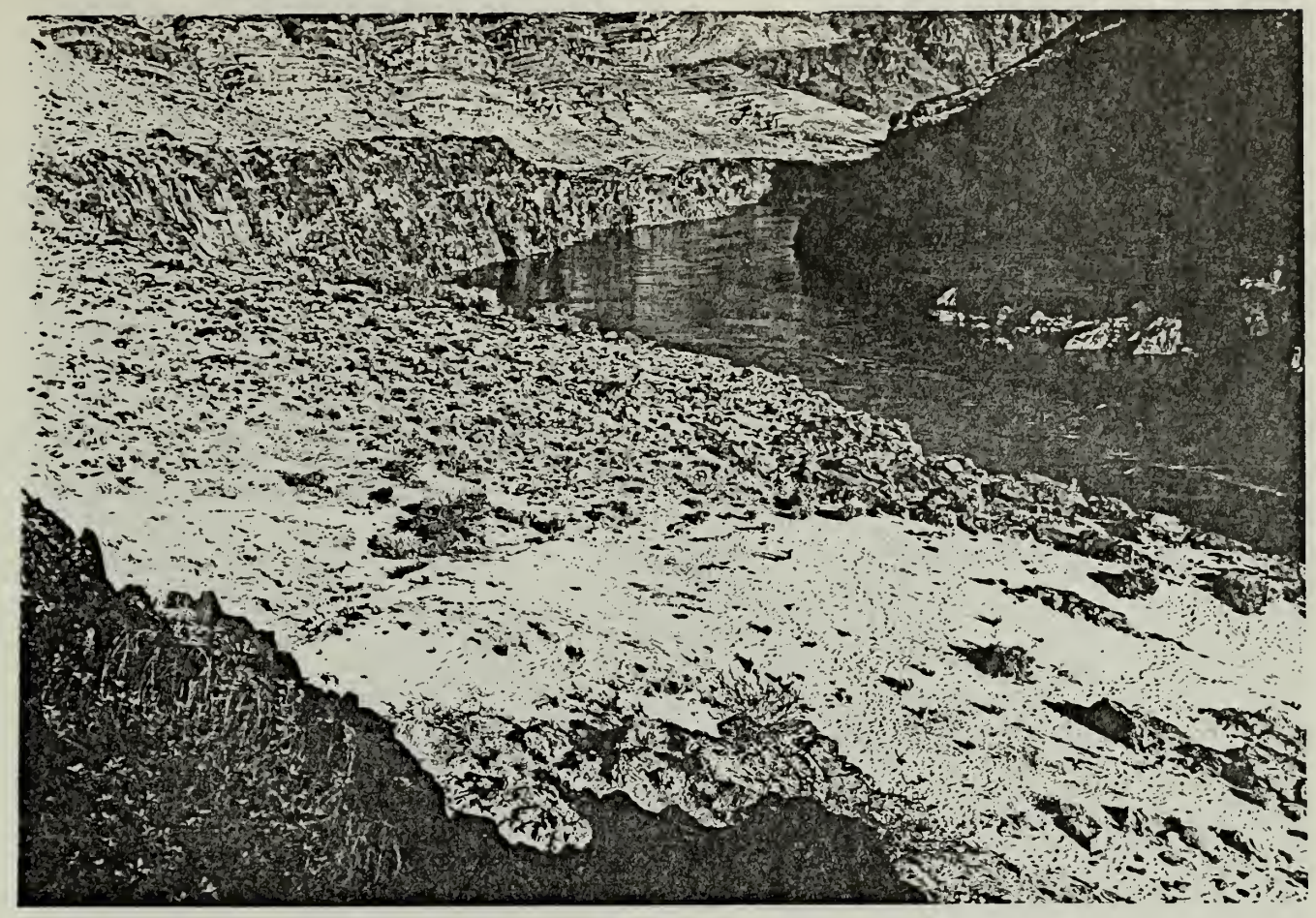

Figure 7: Lower Bass Camp - River Mile 108.5 - Right Bank

This site is located along the right bank of the river and is near the lower end of Upper Granite Gorge. The camp site is separated from Shinumo Creek by a high jutting mass of Vishnu Schist. The lower Grand Canyon Series is exposed above the Granite Gorge. Mammals taken at Lower Bass were Tadarida brasiliensis, Peromysius crinitus, Peromyscus eremicus and Neotoma lepida. Although no burro were seen at this site there were numerous droppings. The following reptiles and amphibians were collected: Bufo punctatus, Cnemidophorus tigris, Sceloporus magister, Uta stansburiana, Urosaurus ornatus, and Crotaphytus insularis. We do not have adequate plant samples from this site.

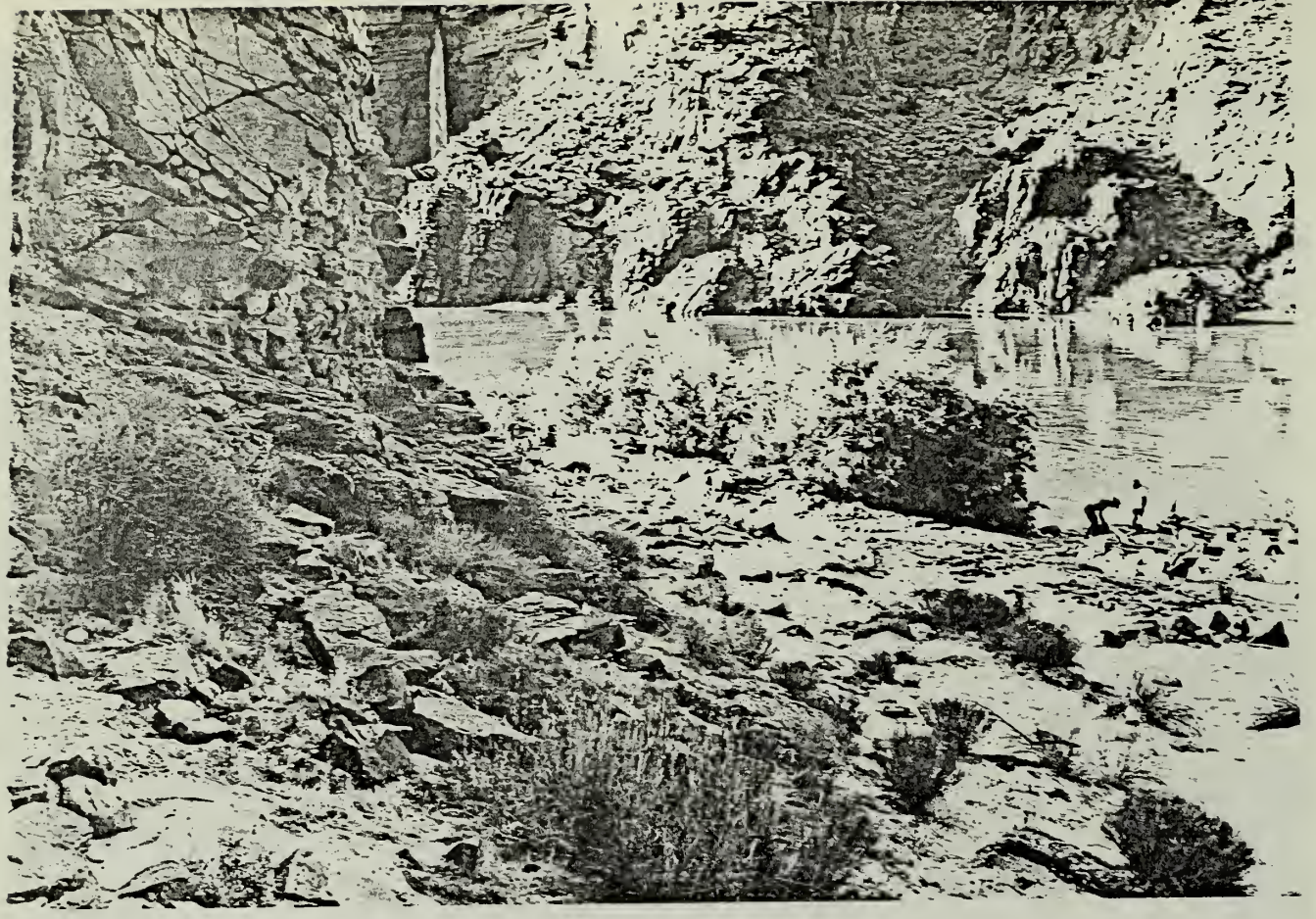

Figure 8: Deer Creek Camp - River Mile 136.2 - Left Bank

Deer Creek study area is along the left bank directly opposite Deer Creek falls. We have included the samples taken at the overhang (Mile 137) together with the specimens collected from the camp area directly across from the falls. The slopes immediately along the river are composed of Vishnu Schist and Zoroaster Granite. Much of the surface is buried under debris from the formations above. The Tapeats Sandstone forms a cliff above the schist and granite. We have only a few plant samples from this site, which is definitely inadequate for a base-line reference. Mammals taken at this site were Pipistrellus hesperus, Perognathus intermedius, Peromyscus crinitus, Peromyscus eremicus, Neotoma lepida, and Spilogale putorius. The herpetofauna collected at either the camp area or from around the Deer Creek falls were Bufo punctatus, Coleonyx variegatus, Cnemidophorus tigris, Sceloporus magister, Uta stansburiana, Crotaphytus insularis, and Lampropeltis getulus.

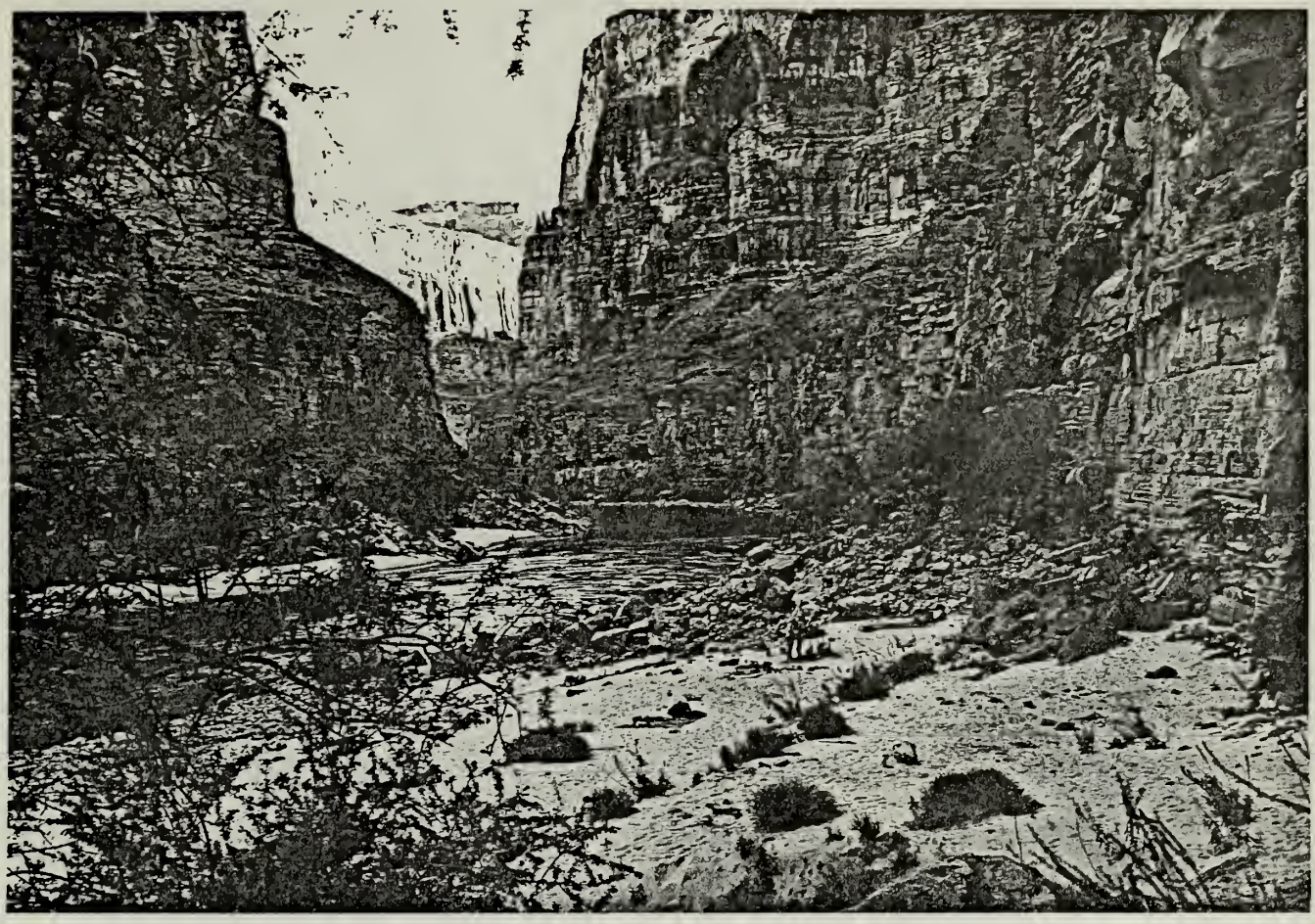

Figure 9: Tuckup Canyon - River Mile 164.5 - Right Bank

Tuckup Canyon is a steep-walled canyon along the right side of the river. It has formed a small narrow deltaic fan along the nearly vertical wall of the Muav, Devonian and Redwall limestones. Not far downriver the underlying beds of Bright Angel Shale are exposed at river level. Mammals collected at Tuckup Canyon site were Plecotus townsendii, Peromyscus boylii, Peromyscus crinitus, Peromyscus eremicus, Peromyscus truei, and Neotoma lepida. During the two visits to this site there was insufficient time to make adequate samples of reptiles, amphibians and plants. Bufo punctatus was the only amphibian taken at Tuckup Canyon.

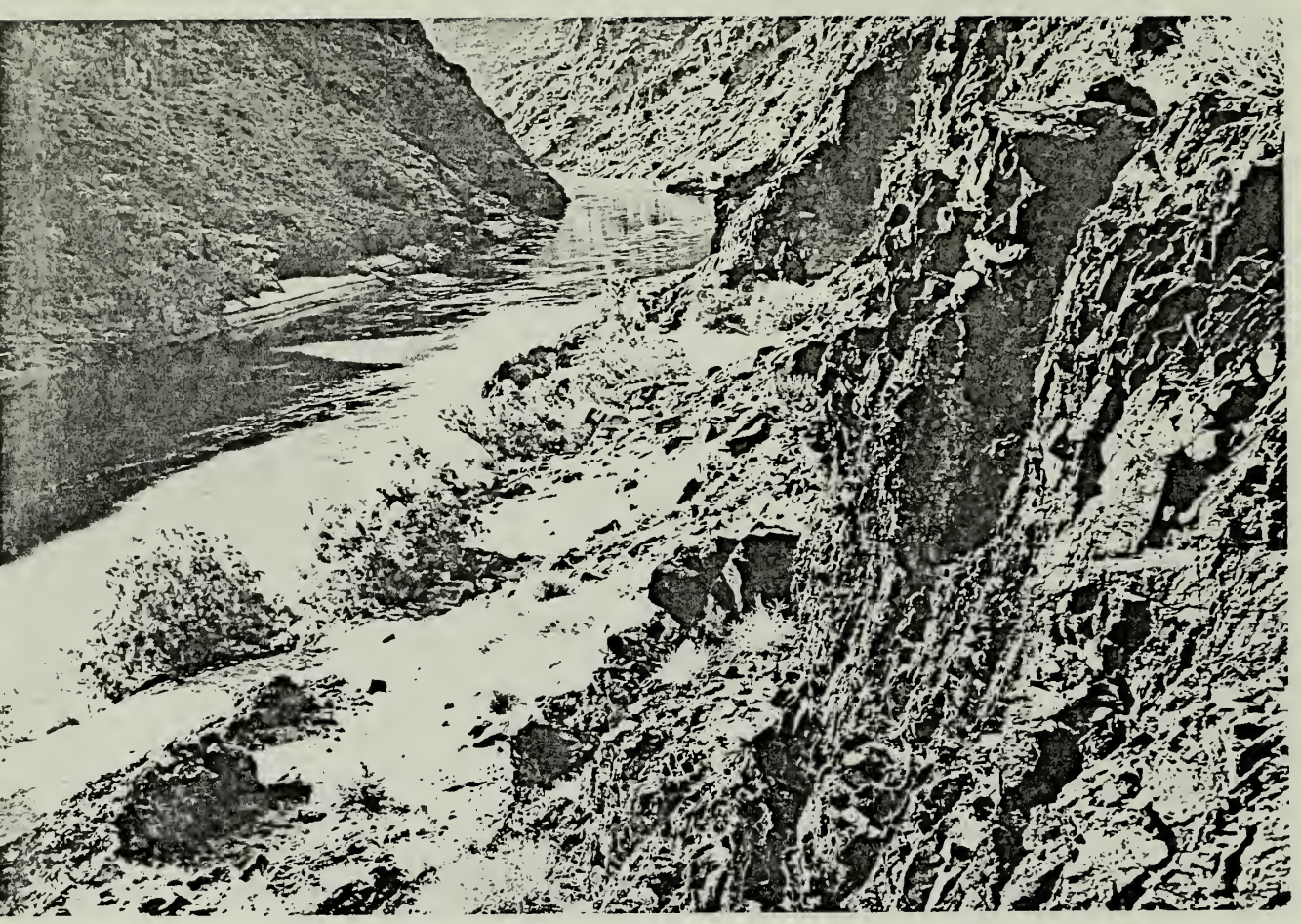

Figure 10: Bridge Canyon Dam Site - River Mile 238 - Left Bank

This site is along the left bank in Lower Granite Gorge. The steep jagged slope extends down to the river's edge. A small collection of plants was obtained from this site during the June 1976 trip, thus additional collecting is needed. Mammals taken at this site included Perognathus intermedius, Peromyscus crinitus, Peromyscus eremicus and Neotoma lepida. Reptiles and amphibians collected were Bufo punctatus, Hyla arenicolor, Cnemidophorus tigris, and Uta stansburiana.

Figure 11: Scorpion Island - River Mile 279.5 - Left Bank

This is our lowermost study site and is outside of the Grand Wash Cliffs along the south shore of the Mead Reservoir. The Grand Wash Cliffs forms the western limit of the Colorado Plateau and the eastern limit of the Basin and Range Province. The latter area at the vicinity of Scorpion Island has a much lower profile than the Colorado Plateau. The top of the Grand Wash Cliffs is approximately 1000 meters above the Basin and Range Province at the Scorpion Island site.

Figure 11 illustrates the flat terrace of gravels and sand that has an abrupt concave slope down to the water's edge. A few types of desert scrub including creosote bush are widely spaced over the terrace. Tamarix is established along the bottom of the slope along the shore line. Mammals collected from the Scorpion Island site included Ammospermophilus harrisii, Perognathus intermedius, Dipodomys merriami and Peromyscus eremicus. There was insufficient time to collect plant and herpetofauna samples. No amphibians were taken at this site. The following reptiles were collected in late afternoon: Uta stansburiana, Callisaurus draconoides and Masticophis flagellum.

Conclusions

No observations were recorded in which float parties had any direct effect upon the fishes. It is conceivable that a concentration of persons using detergents, washing soaps and the like along one of the small tributaries could be detrimental to the fishes particularly during spawning or spawned eggs or hatching fry. Thus the regulation against this practice should be continued. The main adverse impact on the fishes are the impoundment (Glen Canyon Dam particularly) and the physical and chemical characteristics imposed on the area downstream by the unnatural releases of cold bottom waters. This is discussed in relation to the humpback sucker, the hybrid combination between the humpback sucker and the flannelmouth sucker, the genus Gila, in the paragraph on the Colorado squawfish, in the paragraph on the rainbow trout and in the section on the carp in the section on "Fishes". In addition a listing of recorded temperatures is given in Appendix E. The native fishes evolved and were adapted to a different set of environmental conditions than what now prevails and thus those species that are strictly inhabitants of the main river are the first to disappear. Monitoring studies must be done to determine trends in the status of the populations.

No adverse effects of people activity was noted with regards to small mammal populations. Also we did not observe any adverse effect of people on the reptile and amphibian populations. In some camps the flies that were attracted by food of the float parties were preyed upon by the lizards.

The invasion of native and exotic plants probably will have some influence on shifts in composition of mammalian, reptilian and amphibian populations. Needless to say this can not be determined without a good base-line survey and subsequent monitoring surveys.

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HOLDEN, PAUL B. and C.B. STALNAKER. 1970. Systematic studies of the cyprinid genus Gila, in the Upper Colorado River Basin. Copeia, 1970(3): 409-420.

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STEBBINS, ROBERT C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston, pp i-xiv+1-279.

APPENDIX A

Collection Record

Fishes - Grand Canyon

Collection No.	Collection Site	Date
RDS 4834	Mile 17 - R House Rock	7 Sep. 1970
RDS 4835	Mile 44 - L Pres. Harding Rapid	8 Sep. 1970
RDS 5064	Mile 41 - R Buck Farm	10 Aug. 1971
RDS 5065	Mile 65.8 - L Lava Canyon Rapid	12 Aug. 1971
RDS 5066	Mile 116.5 - L Royal Arch Creek	14 Aug. 1971
RDS 5067	Mile 134 - R Tapeats Creek	14 Aug. 1971
RDS 5068	Mile 136.2 - R Deer Creek	14 Aug. 1971
RDS 5069	Mile 194.5 - L	16 Aug. 1971
RDS 5070	Mile 212.5 - L	16 Aug. 1971
RDS 5274	Mile 0 - R Paria River	19 July 1972
RDS 5275	Mile 61.5 - L Little Colorado River	22 July 1972
RDS 5276	Mile 108.7 - R Shinumo Creek	23 July 1972
RDS 5277	Mile 116.5 - L Royal Arch Creek	24 July 1972
RDS 5278	Mile 134 - R Tapeats Creek	24 July 1972
RDS 5279	Mile 136.2- R Deer Creek	25 July 1972
RDS 5280	Mile 148 - L Matkatamiba Creek	25 July 1972
RDS 5281	Mile 156.7 - L Havasu Creek	26 July 1972
RDS 5282	Mile 166.5 - L National Canyon	26 July 1972
RDS 5283	Mile 225.5 - L Diamond Creek	27 July 1972
RDS 5406	Mile 116.5 - L Royal Arch Creek	23 May 1973
RDS 5407	Mile 136.2 - R Deer Creek	23 May 1973
RDS 5408	Mile 156.7 - L Havasu Creek	24 May 1973
RDS 5409	Mile 229 - L Travertine Creek	26 May 1973

RDS 5448	Mile 0 - R Paria River	7 Aug. 1973
RDS 5449	Mile 1 - L "LOST"	8 Aug. 1973
RDS 5450	Mile 31.7 - R "LOST"	9 Aug. 1973
RDS 5451	Mile 41 - R "LOST"	9 Aug. 1973
RDS 5452	Mile 61.5 - L "LOST"	10 Aug. 1973
RDS 5453	Mile 65.6 - L "LOST"	10 Aug. 1973
RDS 5454	Mile 116.5 - L Royal Arch Creek	13 Aug. 1973
RDS 5455	Mile 136.2 - R Deer Creek	13 Aug. 1973
RDS 5626	Mile 0 - R Paria River	17 May 1974
RDS 5627	Mile 61.5 - L Little Colorado River	22 May 1974
RDS 5628	Mile 116.5 - L Royal Arch Creek	24 May 1974
RDS 5629	Mile 156.7 - L Havasu Creek	25 May 1974
RDS 5904	Mile 0 - R Paria River	21 Apr. 1975
RDS 5905	Mile 19 - L	22 Apr. 1975
RDS 5906	Mile 41 - R Buck Farm	24 Apr. 1975
RDS 5907	Mile 50 - R	25 Apr. 1975
RDS 5908	Mile 61.5 - L Little Colorado River	26 Apr. 1975
RDS 5909	Mile 71 - L Cardenas Creek Camp	26 Apr. 1975
RDS 5910	Mile 87.5 - R	27 Apr. 1975
RDS 5911	Mile 87.7 - R Bright Angel Creek	27 Apr. 1975
RDS 5912	Mile 98.2 - R Crystal Creek	28 Apr. 1975
RDS 5913	Mile 108.7 - R Shinumo Creek	29 Apr. 1975
RDS 5914	Mile 116.5 - L Royal Arch Creek	29 Apr. 1975
RDS 5915	Mile 134 - R Tapeats Creek	30 Apr. 1975
RDS 5916	Mile 136.2 - R Deer Creek	30 Apr. 1975

RDS 5917	Mile 143.5 - R Kanab Creek	1 May 1975
RDS 5918	Mile 156.7 - L Havasu Creek	2 May 1975
RDS 5931	Mile 0 - R Paria River	2 June 1975
RDS 5932	Mile 0 - R Paria River	3 June 1975
RDS 5933	Mile 61.5 - L Little Colorado River	5 June 1975
RDS 5934	Mile 84.2 - R Clear Creek	6 June 1975
RDS 5935	Mile 87.7 - R Bright Angel Creek	6 June 1975
RDS 5936	Mile 95 - L Hermit Creek	6 June 1975
RDS 5937	Mile 96.5 - L Boucher Creek	6 June 1975
RDS 5938	Mile 98.2 - R Crystal Creek	6 June 1975
RDS 5939	Mile 108.7 - R Shinumo Creek	7 June 1975
RDS 5940	Mile 116.5 - L Royal Arch Creek	7 June 1975
RDS 5941	Mile 120 - R Blacktail Canyon Creek	8 June 1975
RDS 5942	Mile 132 - R Stone Creek	8 June 1975
RDS 5943	Mile 134 - R Tapeats Creek	9 June 1975
RDS 5944	Mile 136.2 - R Deer Creek	9 June 1975
RDS 5945	Mile 143.5 - R Kanab Creek	9 June 1975
RDS 5946	Mile 209 - L Granite Park	11 June 1975
RDS 5947	Mile 225.5 - L Diamond Creek	12 June 1975
RDS 5975	Mile 61.5 - L Little Colorado	30 July 1975
RDS 5976	Mile 84.2 - R Clear Creek	30 July 1975
RDS 5977	Mile 87.7 - R Bright Angel Creek	31 July 1975
RDS 5978	Mile 98.2 - R Crystal Creek	1 Aug. 1975

RDS 5979	Mile 108.7 - R Shinumo Creek	1 Aug. 1975
RDS 5980	Mile 116.5 - L Royal Arch Creek	2 Aug. 1975
RDS 5981	Mile 132 - R Stone Creek	2 Aug. 1975
RDS 5982	Mile 136.2 - R Deer Creek	2 Aug. 1975
RDS 5983	Mile 143.5 - R Kanab Creek	3 Aug. 1975
RDS 5984	Mile 148 - L Matkatamiba Creek	3 Aug. 1975
RDS 5985	Mile 156.7 - L Havasu Creek	3 Aug. 1975
RDS 5986	Mile 209 - L Granite Park	4 Aug. 1975
RDS 5987	Mile 246 - L Spencer Creek	5 Aug. 1975
RDS 5988	Mile 274.3 - L Emory Falls	5 Aug. 1975
RDS 5989	Mile 279.5 - L Scorpion Island	5 Aug. 1975
RDS 5990	Mile 280 - L Pierce Landing	6 Aug. 1975
RDS 5991	Mile 0 - R Paria River	7 Aug. 1975
RDS 6033	Mile 61.5 - L Little Colorado River	22 Sep. 1975
RDS 6034	Mile 69 - L Lava Canyon Rapid	22 Sep. 1975
RDS 6035	Mile 71 - L Cardenas Creek Camp	22 Sep. 1975
RDS 6036	Mile 108.7 - L Shinumo Creek	23 Sep. 1975
RDS 6037	Mile 116.5 - L Royal Arch Creek	24 Sep. 1975
RDS 6038	Mile 136.2 - R Deer Creek	24 Sep. 1975
RDS 6039	Mile 0 - R Paria River	27 Sep. 1975
RDS 6071	Mile 0 - R Paria River	15 Nov. 1975
RDS 6072	Mile 0 - R Paria River	16 Nov. 1975
RDS 6139	Mile 0 - R Paria River	3 Apr. 1976
RDS 6140	Mile 0 - R Paria River	5 Apr. 1976

RDS 6142	Mile 0 - R Paria River	1 May 1976
RDS 6143	Mile 0 - R Paria River	2 May 1976
RDS 6144	Mile 0 - R Paria River	3 May 1976
RDS 6145	Mile 0 - R Paria River	4 May 1976
RDS 6146	Mile 61.5 - L Little Colorado River	5 May 1976
RDS 6147	Mile 65.8 - L Lava Canyon Rapid	6 May 1976
RDS 6161	Mile 0 - R Paria River	30 May 1976
RDS 6162	Mile 41 - R Buck Farm	1 June 1976
RDS 6163	Mile 61.5 - L Little Colorado River	2 June 1976
RDS 6164	Mile 71 - L Cardenas Creek Camp	2 June 1976
RDS 6165	Mile 87.7 - R Bright Angel Creek	3 June 1976
RDS 6166	Mile 96.5 - L Boucher Creek	3 June 1976
RDS 6167	Mile 98.2 - R Crystal Creek	4 June 1976
RDS 6168	Mile 108.7 - R Shinumo Creek	4 June 1976
RDS 6169	Mile 116.5 - L Royal Arch Creek	5 June 1976
RDS 6170	Mile 143.5 - R Kanab Creek	6 June 1976
RDS 6171	Mile 246 - L Spencer Creek	8 June 1976

APPENDIX B

Species Collected

Fishes - Grand Canyon

I	*Dorosoma petenense*	Threadfin shad
I	*Oncorhynchus kisutch*	Coho salmon
I	*Salmo gairdneri*	Rainbow trout
N	*Catostomus latipinnis*	Flannelmouth sucker
N	*Pantosteus discobolus*	Bluehead sucker
I	*Cyprinus carpio*	Carp
N	*Gila cypha*	Humpback chub
I	*Lepidomeda mollispinis*	Virgin spinedace
I	*Notemigonus crysoleucas*	Golden shiner
I	*Notropis lutrensis*	Red shiner
I	*Pimephales promelas*	Fathead minnow
N	*Rhinichthys osculus*	Speckled dace
I	*Ictalurus punctatus*	Channel catfish
I	*Fundulus zebrinus*	Rio Grande killifish
I	*Gambusia affinis*	Mosquitofish
I	*Morone saxatilis*	Striped bass
I	*Lepomis cyanellus*	Green sunfish
I	*Lepomis macrochirus*	Bluegill
I	*Micropterus salmoides*	Largemouth bass

I= introduced
N= native

APPENDIX C

Collection Record

Mammals - Grand Canyon

Collection No.	Collection Site	Date
RDS-M-71-200	Mile 22 - L	9 Aug. 1971
RDS-M-71-201-211	Mile 41 - R Buck Farm	10 Aug. 1971
RDS-M-71-212	Mile 136.2 - L Deer Creek Camp	14 Aug. 1971
RDS-M-71-213-219	Mile 171.5 - L Mohawk Canyon	15 Aug. 1971
RDS-M-71-220-221	Mile 212.5 - L	16 Aug. 1971
RDS-M-73-346-347	Mile 22 - L	21 July 1972
RDS-M-72-348-349	Mile 44 - L Pres. Harding Rapids	21-22 July 1972
RDS-M-73-350-356	Mile 71 - R Unkar	23 July 1972
RDS-M-72-357-358	Mile 114- R	24 July 1972
RDS-M-72-359-376	Mile 136.2 - L	24-25 July 1972
RDS-M-72-377	Mile 151.5 - R	26 July 1972
RDS-M-72-378-388	Mile 188 - R Whitmore Wash	26-27 July 1972
RDS-M-72-388-393	Mile 238 - L Bridge Canyon Dam site	28 July 1972
RDS-M-72-394-406	Mile 294.5 - L Sandy Point	28-29 July 1972
RDS-M-73-462-466	Mile 50 - R Little Nankoweap	20-21 May 1973
RDS-M-73-468-474	Mile 136.2 - L Deer Creek Camp	23-24 May 1973
RDS-M-73-475-481	Mile 166.5 - L National Canyon	25 May 1973
RDS-M-73-482	Mile 220 - R	26 May 1973
RDS-M-73-483-493	Mile 22.5 - L	8-9 Aug. 1973
RDS-M-73-494-513	Mile 41 - R	9-10 Aug. 1973
RDS-M-73-514-521	Mile 65.5 - L Palisades Creek	10-11 Aug. 1973
RDS-M-73-522-528	Mile 99.5 - L Tuna Creek	12 Aug. 1973
RDS-M-73-529	Mile 112 - R D.O. River	12 Aug. 1973
RDS-M-73-530	Mile 114 - R	12 Aug. 1973
RDS-M-73-531-537	Mile 137 - L Deer Creek Camp	13-14 Aug. 1973
RDS-M-73-538-547	Mile 182.5 - R	14-15 Aug. 1973

RDS-M-73-548-571	Mile 238 - L Bridge Canyon Dam site	15-16 Aug. 1973
RDS-M-73-572	Mile 0 - R Lee's Ferry	18 Aug. 1973
RDS-M-74-644-650	Mile 0 - R Lee's Ferry	18 May 1974
RDS-M-74-651-658	Mile 20 - L	20-21 May 1974
RDS-M-74-659-671	Mile 56.5 - R Kwagunt Creek	21-22 May 1974
RDS-M-74-672-678	Mile 71 - R Unkar	22 May 1974
RDS-M-74-679-688	Mile 108.5 - R Lower Bass Camp	23 May 1974
RDS-M-74-689-695	Mile 136.8 - L Deer Creek Camp	24 May 1974
RDS-M-74-696-697	Mile 168- R Fern Glen Canyon	25-26 May 1974
RDS-M-74-698-705	Mile 220 - R	26-27 May 1974
SWC 730-733	Mile 19 - L	23 Apr. 1975
RDS-M-75-726-734	Mile 41 - R Buck Farm	23-24 Apr. 1975
RDS-M-75-735-751	Mile 50 - R Little Nankoweap	24-26 Apr. 1975
RDS-M-75-752-757	Mile 71 - L Cardenas Creek	26 Apr. 1975
RDS-M-75-758-759	Mile 71 - R Unkar	26-27 Apr. 1975
RDS-M-75-760-764	Mile 108.5 - R Lower Bass Camp	28-29 Apr. 1975
RDS-M-75-765-767	Mile 124 - L	29-30 Apr. 1975
RDS-M-75-768-773	Mile 139- R Fishtail Canyon	30- 1 May 1975
RDS-M-75-774	Mile 152 - R	2 May 1975
RDS-M-75-775-785	Mile 168 - R Fern Glen Canyon	2- 3 May 1975
RDS-M-75-786-794	Mile 196.5 - L	3- 4 May 1975
RDS-M-75-802	Mile 0 - R Lee's Ferry	2 June 1975
RDS-M-75-803-806	Mile 19 - L	4 June 1975
RDS-M-75-807-816	Mile 41 - R Buck Farm	4- 5 June 1975
RDS-M-75-817-823	Mile 72 - R Unkar	5- 6 June 1975
RDS-M-75-824-828	Mile 98.2 - R Crystal Creek	6- 7 June 1975
RDS-M-75-829-837	Mile 119.5 - L	7- 8 June 1975

RDS-M-75- 838- 845	Mile 132 - R Stone Creek	8- 9 June 1975
RDS-M-75- 861- 867	Mile 17 - R House Rock	28-29 July 1975
RDS-M-75- 868- 883	Mile 41 - R Buck Farm	29-30 July 1975
RDS-M-75- 884- 897	Mile 72 - R Unkar	30-31 July 1975
RDS-M-75- 898- 915	Mile 96.5 - L Boucher Creek	31- 1 Aug. 1975
RDS-M-75- 916- 923	Mile 114 - R	1- 2 Aug. 1975
RDS-M-75- 924- 935	Mile 137 - L Deer Creek Camp	2- 3 Aug. 1975
RDS-M-75- 936- 957	Mile 164.5 - R Tuckup Canyon	3- 4 Aug. 1975
RDS-M-75- 958- 972	Mile 238-L Bridge Canyon Dam site	4- 5 Aug. 1975
RDS-M-75- 973- 988	Mile 279.5 - L Scorpion Island	5- 6 Aug. 1975
RDS-M-75- 991- 993	Mile 26 - L	19-20 Sep. 1975
RDS-M-75-1001-1010	Mile 56 - R Kwagunt Creek	21-22 Sep. 1975
RDS-M-75-1011-1022	Mile 72 - R Unkar	22-23 Sep. 1975
RDS-M-75-1023	Mile 108.5 - R	23 Sep. 1975
RDS-M-75-1024-1031	Lower Bass Camp	
RDS-M-75-1024-1031	Mile 168 - R Fern Glen Canyon	24-25 Sep. 1975
RDS-M-75-1032	Mile 220 - R	25-26 Sep. 1975
RDS-M-75-1033-1036	Mile 0 - R Lee's Ferry	29 Sep. 1975
RDS-M-76-1046-1064	Mile 0 - R Lee's Ferry	4- 5 Apr. 1976
RDS-M-76-1069-1085	Mile 0 - R Lee's Ferry	3- 4 May 1976
RDS-M-76-1090	Mile 0 - R Lee's Ferry	30 May 1976
RDS-M-76-1091-1104	Mile 19 - L	31 May 1976
CJ 5366-5406	Mile 41 - R Buck Farm	1 June 1976
RDF 1505-1543	Mile 72 - R Unkar	2 June 1976
RDS-M-76-1105-1119	Mile 96.5 - L Boucher Creek	3 June 1976
CJ 5407-5427 A	Mile 108.5 - R Lower Bass Camp	4 June 1976
RDS 1544-1564	Mile 136.2 - L Deer Creek Camp	5 June 1976

RDS-M-76-1120-1132	Mile 164.5 - R Tuckup Canyon	6 June 1976
CJ 5427B-5451	Mile 238 - L Bridge Canyon Dam site	7 June 1976
RDF 1565-1589	Mile 279.5 - L Scorpion Island	8 June 1976

APPENDIX D

Species Collected

Mammals - Grand Canyon

Myotis californicus	California myotis
Myotis thysanodes	Fringed myotis
Myotis yumanensis	Yuma myotis
Pipistrellus hesperus	Western pipistrelle
Plecotus townsendii	Bigear bat
Antrozous pallidus	Pallid bat
Tadarida brasiliensis	Freetail bat
Ammospermophilus harrisii	Yuma antelope squirrel
Ammospermophilus leucurus	Whitetail antelope squirrel
Citellus variegatus	Rock squirrel
Perognathus	
Perognathus formosus	Longtail pocket mouse
Perognathus intermedius	Rock pocket mouse
Dipodomys merriami	Merriam kangaroo rat
Reithrodontomys megalotis	Western harvest mouse
Peromyscus boylii	Brush mouse
Peromyscus crinitus	Canyon mouse
Peromyscus eremicus	Cactus mouse
Peromyscus maniculatus	Deer mouse
Peromyscus truei	Pinon mouse
Neotoma albigula	Whitethroat wood rat
Neotoma lepida	Desert wood rat
Spilogale putorius	Spotted skunk
Ovis canadensis	Bighorn sheep

APPENDIX E

Collection Sites

Herpetofauna - Grand Canyon

	River Mile	
	Left	Right
Bufo punctatus	19	0
	96.5	41
	116.4	98.2
	168	108.8
	238	132
	246	136.5
		164.5
Bufo woodhousei	4	0
	19	41
	32	98.2
	95	
Hyla arenicolor	96.5	0
	179.3	41
	238	98.2
	246	116.5
		132
		169.5
Scaphiopus hammondi	19	
Coleonyx variegatus	96.5	
	136	
Cnemidophorus tigris	4	0
	19	32
	61.5	41
	116.4	84.2
	136	87.5
	209	108.5
	238	136.3
	279.5	143

Sceloporus magister	4	0
	19	31.7
	61.5	32
	116.4	41
	136	72
	150.5	87.5
	157	98.2
	209	108.5
	246	126
		132
		133.8
		134
		136.3
		143
		151.5
Uta stansburiana	19	0
	61.5	0.2
	71	41
	96.5	72
	119.5	98.2
	136	108.5
	238	132
	246	143
	279.5	
Urosaurus ornatus	4	32
	19	84
	29	108.5
	32	126
	116.4	132
	150.5	133
		134
		136
Callisaurus draconoides	279.5	
Sauromalus obesus	29	84.2
	71	98
	156.9	132
		136
Crotaphytus insularis	71	0.2
		72
		108.5
		134
		136

Hypsiglena torquata	196.5	
Lampropeltis getulus		136.3
Masticophis flagellum	279.5	
Masticophis taeniatus	90	
Salvadora hexalepis	65.8	0.2
Sonora semiannulata	229.5	
Crotalus viridis	99.3 150.5 246	179.5

APPENDIX F

Species Collected

Herpetofauna - Grand Canyon

Bufo punctatus	Redspotted toad
Bufo woodhousei	Woodhouse toad
Hyla arenicolor	Canyon treefrog
Scaphiopus hammondi	Western spadefoot
Coleonyx variegatus	Banded gecko
Cnemidophorus tigris	Western whiptail
Sceloporus magister	Desert spiny lizard
Uta stansburiana	Sideblotch lizard
Urosaurus ornatus	Tree lizard
Callisaurus draconoides	Zebratail lizard
Sauromalus obesus	Chuckwalla
Crotaphytus insularis	Desert collared lizard
Hypsiglena torquata	Night snake
Lampropeltis getulus	Common kingsnake
Masticophis flagellum	Coachwhip
Masticophis taeniatus	Striped whipsnake
Salvadora hexalepis	Western patchnose snake
Sonora semiannulata	Western ground snake
Crotalus viridis	Western rattlesnake

APPENDIX G
Collection Record

Plants - Grand Canyon

Collection No.	Collection Site	Date
RDS-73-015	River Mile 20 - L	19 May 1973
RDS-73-016	River Mile 50 - R	20 May 1973
RDS-73-017	River Mile 110 - R	22 May 1973
RDS-73-018	River Mile 166.5 - L National Canyon	24 May 1973
RDS-73-019	River Mile 220 - R	26 May 1973
RDS-73-020	River Mile 294.5 - L Sandy Point	27 May 1973
RDS-75-007	River Mile 134 - R Tapeats Creek	20 Apr. 1975
RDS-75-008	River Mile 168 - R Fern Glen Canyon	2 May 1975
RDS-75-009	River Mile 219 - R Trail Canyon	4-5 May 1975
RDS-75-010	River Mile 225 - L Diamond Creek	5 May 1975
RDS-75-011	River Mile 219 - R Trail Canyon	11 June 1975
RDS-75-012	River Mile 41 - R Buck Farm Canyon	29 July 1975
RDS-75-013	River Mile 179- R Lava Falls Rapid	4 Aug. 1975
RDS-75-014	River Mile 209 - L Granite Park	4 Aug. 1975
RDS-75-015	River Mile 26 - L	20 Sep. 1975
RDS-75-016	River Mile 41 - R Buck Farm Canyon	20 Sep. 1975
RDS-75-017	River Mile 47 - R Saddle Canyon	21 Sep. 1975
RDS-75-018	River Mile 56 - R Kwagunt Creek	21 Sep. 1975
RDS-75-019	River Mile 72 - R Unkar	22 Sep. 1975
RDS-75-020	River Mile 108.5 - R Lower Bass Camp	23 Sep. 1975
RDS-75-021	River Mile 168 - R Fern Glen Canyon	24 Sep. 1975
RDS-75-022	River Mile 195 - L	25 Sep. 1975
RDS-75-023	River Mile 209 - R	25 Sep. 1975
RDS-75-024	River Mile 220 - R 220 Mile Canyon	25 Sep. 1975
RDS-75-025	River Mile 0 - R Lee's Ferry	29 Sep. 1975

RDS-76-008	River Mile 0 - R Lee's Ferry	1 Mar. 1976
RDS-76-012	River Mile 0 - R Lee's Ferry	4 Apr. 1976
RDS-76-018	River Mile 0 - R Lee's Ferry	2-3 May 1976
RDS-76-019	River Mile 61.5 - L Little Colorado	6 May 1976
RDS-76-020	River Mile 65.8 - L Lava Canyon Rapids	7 May 1976
RDS-76-022	River Mile 0 - R Lee's Ferry	30 May 1976
RDS-76-023	River Mile 19 - L	31 May 1976
RDS-76-024	River Mile 41 - R Buck Farm Canyon	1 June 1976
RDS-76-025	River Mile 72 - R Unkar	2 June 1976
RDS-76-026	River Mile 96.5 - L Boucher Creek	3 June 1976
RDS-76-027	River Mile 108.5 - R Lower Bass Camp	4 June 1976
RDS-76-028	River Mile 116.5 Elves Chasm	5 June 1976
RDS-76-029	River Mile 134 - R Tapeats Creek	5 June 1976
RDS-76-030	River Mile 136.2 - L Deer Creek Camp	5 June 1976
RDS-76-031	River Mile 136.2 - R Deer Creek Canyon	6 June 1976
RDS-76-032	River Mile 164.5 Tuckup Canyon	6 June 1976
RDS-76-033	River Mile 209 - L Granite Park	7 June 1976
RDS-76-034	River Mile 238 - L Bridge Canyon Dam site	7 June 1976
RDS-76-035	River Mile 279.5 - L Scorpion Island	8 June 1976

APPENDIX

Water temperatures for May 30 - June 9, 1976
Grand Canyon trip

Date	River Mile	Name of Tributary	Temp. of Tributary	Temp. of Colorado River
May 30	0	Paria River	22°C-24°C	10°C
June 1	41			11.5°C
June 2	61.5	Little Colorado	18°C	11.5°C
June 2	71	Cardenas marsh	18°C	11.5°C
June 3	87.7	Bright Angel Cr.	21°C	10°C
June 3	96.5	Boucher Creek	24°C	
June 4	98.2	Crystal Creek	25°C	11.5°C
June 4	108.7	Shinumo Creek	23°C	11.5°C
June 5	116.5	Royal Arch Creek	17°C	
June 6	143.5	Kanab Creek	25°C	13°C
June 8	246	Spencer Creek	27.5°C	12°C

Recommendations

The following recommendations are those of Royal D. Suttkus. Logistics and lack of budget make it unfeasable to obtain group recommendations.

1. More basic information is needed for most of our ten sites. 24 27

2. Regulations with regards to detergents, etc. should be continued. 29

3. Regulations with regards to vegetable seeds should be continued. 15

4. No alterations (such as dams) should be allowed anywhere along Little Colorado River. 9

5. Monitoring programs should follow the basic survey period of the ten sites. 29

6. Monitoring studies of the Gila population in the Grand Canyon should be carried on for a couple of years to determine population trends and spawning success.

7. Restoration of habitat is an absolute prerequisite to a recovery program for the genus Gila in the Grand Canyon area.

8. Economic, biological, political, and time facets should be explored for every conceivable plan to restore the habitat. A plan to restore a portion of the Colorado River in the Grand Canyon area on a seasonal (to coincide with spawning of Gila) basis should be explored.

Possible plans:

a. Removal of Glen Canyon Dam.

b. Construction of by-pass around Glen Canyon Dam.

c. Construction of by-passes for shunting of surface water.

d. Construction of tunnel to shunt surface water from Powell Reservoir into Paria River.